THE OPERATIVE TREATMENT OF ACUTE ABSCESS OF THE LUNG.*

BY BENJAMIN T. TILTON, M.D.,
OF NEW YORK,
Assistant Surgeon to Bellevue Hospital; Surgeon to Lincoln Hospital.

THE operative treatment of abscess of the lung, while it goes back to Hippocrates, was not put upon a sound basis until the latter part of the last century. Hippocrates recognized that abscesses of the lung not unfrequently ruptured into a bronchus and could thus be healed spontaneously, and in other cases broke into the pleura and then justified incision or opening with a cautery. In the eighteenth century De Barry and, later, Sharpe recommended operative procedures for abscess and other cavities. In 1845 Stokes attempted the opening of pulmonic cavities with the trocar. In 1873 Mosler, an internist, inaugurated the present period of lung surgery. Since then Quincke, Tuffier, Gluck, Karewski, and Garré have been important contributors to this branch of surgery. Progress became more rapid after it had been learned that the dangers of pneumothorax could be avoided, that the lung tissue stood well the invasion of the knife and cautery, and that hemorrhage need not be dreaded.

It is only of late years that an accurate differentiation of the suppurative lesions suitable to surgical treatment has been made, and definite indications and limitations have been laid down for the guidance of those contemplating operative interference. It is still true that lung abscess may present great difficulties of diagnosis, and this is likely to be the case at a stage of the disease when the prospect for a cure by operation is the most hopeful, *i.e.*, in fresh cases with the patient in a good general condition, slight extent of the suppurative process and no complications. In spite of greater accuracy in physical signs, and sputum examinations, and the added information from radiography, the diagnosis of suppurative lesions within the lung is still far from satisfactory. Discrepancies between the findings of the medical men and the revelations of the surgeon and pathologist are still of common occurrence.

---

* Read before the New York Surgical Society, April 24, 1907.

Not only are the various acute and chronic suppurative lesions within the lung itself frequently mistaken for each other, but various conditions outside the lung are often wrongly claimed as intrapulmonic in origin. One has only to read carefully the histories of reported cases of abscess of the lung to find among them many of probable interlobar empyema or an empyema sacculated or general that has broken secondarily into the lung and bronchus. The best observers have been at times unable to distinguish correctly between an encapsulated intraparenchymatous and encapsulated pleuritic collection. It is equally true that many cases of abscess of the lung break into the pleural cavity, causing an empyema, which is drained and the existence of a primary lung abscess never suspected. Many of the instances of the slowly healing empyemas can doubtless be explained on the ground of persistence of a suppurating focus within the lung, which continues to discharge into the pleural cavity. For these reasons the frequency of acute abscess of the lung is stated very differently by different observers. Some of our medical confrères claim that it is a comparatively frequent condition following pneumonia, and point to numerous cases of spontaneous cure from evacuation into a bronchus. It should be borne in mind that a localized empyema may easily give the same physical signs as abscess of the lung, and very commonly perforates like an abscess into the bronchus. Other medical men recognize the infrequency of lung abscess following pneumonia, which is its most common antecedent, and place it among the rarest complications of that disease. Fraenkel, for example, found that in 860 cases of pneumonia under his observation, abscess of the lung occurred only in 1.5 per cent. of the cases.

Within the lung itself the various forms of suppuration are often not differentiated in the lists of reported cases, and are classified together in symptomatology, prognosis, and treatment. While it is true that these different forms may have a resemblance to each other as regards symptoms, they should be strictly differentiated as regards indications *for* and results that may be expected *from* operative treatment. I think from a surgical standpoint we should carefully distinguish: First, acute abscess, simple and gangrenous; second, chronic abscess; third, bronchiectasis. Tuberculosis and actinomycosis belong in a still different category.

Acute abscess has been shown to follow most frequently lobar pneumonia. Tuffier found this to be the case in 23 out of 49 cases. Other causes are septic embolism and extension of suppuration from adjacent parts. The aspiration of foreign bodies usually results in an abscess of the chronic type that may eventually go on to bronchiectasis. The prognosis from the operative treatment of the chronic suppuration is so distinctly in another class from that of the acute that I have preferred to limit myself in this paper to the treatment of the acute. It is by directing our attention to the acute form of suppuration that we shall be able to prevent a certain percentage of the chronic cases which offer such a poor outlook for surgical interference. We cannot trust to Nature for a spontaneous cure by evacuation of the pus through a bronchus. If we could, there would be fewer cases of the chronic form come to our attention. We should interfere at an early stage before the abscess walls and surrounding tissue become hard and indurated, and the adjoining pleura thickened and unyielding, favoring a continuation of the suppuration and preventing a collapse of the abscess walls. The operative treatment of chronic abscess includes so much more than is necessary in acute abscess, and the conditions for healing are so unfavorable, that the two forms of abscess have little in common. To bring a chronic abscess to healing implies usually an extensive resection of ribs, removal, perhaps, of thickened pleura, and even then a sinus is likely to persist. On the other hand, the operative treatment of acute non-gangrenous abscess is in itself simple, and recovery should be the rule. The great difficulty lies in an early recognition of the disease and in an accurate localization of the focus.

As regards the justification for operative interference in abscess of the lung, we must recognize the fact that spontaneous recovery is possible. Many abscesses of pneumococcus origin have undoubtedly healed after evacuation of the pus into a bronchus. In the absence of a gangrenous element, the abscess may not enlarge rapidly nor cause marked septic symptoms. Its walls not having become indurated coalesce after discharge of the pus, and cicatrization may be prompt and complete. On the other hand, we cannot be at all sure that this favorable result will follow. As these abscesses are often near the pleural surface they can easily give rise to empyema, which in such cases runs a severe and protracted course. Furthermore, if they persist as such their walls become thickened and unyielding, and later resist even extensive operative procedures. Spontaneous cures should be looked upon as a fortunate accident, and not waited for to the risk of the patient's life or future condition of health. The continued presence of an abscess within the lung should be regarded as a serious condition. Instead of rupturing into a bronchus it may at any moment break into the pleural cavity, give rise to multiple abscesses in the lung, or cause dangerous septic manifestations. When, however, the abscess has already broken into a bronchus and is discharging freely, it would seem proper to wait a time for nature to finish her cure. Should the discharge of pus per mouth not diminish rapidly, and the septic symptoms continue, we should not delay long. Evidences, however, of a gangrenous nature on the part of the abscess indicate very strongly early operation. The danger here is greater of infecting other parts of the lung and causing general sepsis.

Other reasons justifying some delay in operating are the persistence of the acute pneumonic process and the desirability of having firm adhesions of the two pleural surfaces. These should not, however, be allowed to weigh against early evacuation of the pus when there are well-marked indications for the same. Quincke claims that the duration of the disease has no influence upon the presence of adhesions. Their existence is probable if there is a previous history of sharp pain on that side and other evidences of inflammation of the pleura.

In spite of the fact that the operative technique of pneumotomy is comparatively simple, this operation is often unsatisfactory and disappointments are not uncommon. In the first place the abscess, though present, may not be found. This may be due to the fact that its location has not been accurately made out beforehand. It is one thing to diagnose the existence of an abscess and quite another to locate it exactly. Mistakes can be made as to its height and depth. The experience of the past will help us here. The great majority of abscesses following pneumonia occur in the lower lobe and near the pleural surface. Furthermore, the location of the adhesions between the pleural surfaces is usually an important guide to the situation of the pus cavity. After the exposure of the adherent pleura the aspiration syringe should ordinarily locate the pus if introduced a number of times in different directions and to various depths. If there are no adhesions found at the point where the pleura has been exposed, the proper procedure, it seems to me, is to make a small opening in the parietal pleura large enough to admit a finger, and in this way a search can be made for adhesions. This " exploratory pleurotomy " done in this way, as first recommended by Bazy, may give valuable information, not only as to the location of adhesions, but the focus itself may be made out by feeling a firmer consistency of the lung at one point, a bulging of the surface, or a thickened pleura. The danger of making such a small opening in the pleura which is at once filled with the finger is very slight. The resulting pneumothorax is only partial, particularly if adhesions are present at one or more points, and even without adhesions the collapse of the lung is not complete, and the patient suffers no alarming symptoms. Bazy found in this way a gangrenous focus in the upper lobe of the right lung in a young man of twenty, in spite of the fact that the physical signs pointed to a localization of the cavity in the lower lobe. After resection of the eighth and ninth ribs the pleura was found to be healthy.

Upon inserting the finger he felt higher up an induration of the lung and adhesions. Thereupon he resected the fourth rib and opened an abscess cavity in the subjacent portion of the lung. Such a favorable result cannot, of course, be expected in every case that this method is used, but it seems advisable in cases where no adhesions are found at the point of resection of ribs. By uniting the non-adherent pleural surfaces without this exploration, we lose a valuable diagnostic method. The absence of adhesions carries with it considerable doubt as to whether the abscess will be found directly beneath the exposed pleural surface inasmuch as adhesions are the rule.

The more extensive exploratory operations in which the pleural cavity is opened widely and the lung palpated over its entire surface has no place in suppurative lesions in the lung. The same is true of the extrapleural method of Tuffier, in which the parietal pleura is dissected up for some distance from the subjacent fascia, thus making it possible to palpate the lung without opening the pleural cavity. The first operation is very dangerous on account of the complete pneumothorax and the probable infection of the pleural cavity, provided the abscess is found and opened in the same sitting.

The second operation is very difficult, prolonged and in the end unsatisfactory. Should, in spite of the Bazy procedure, no adhesions at all be found, and the existence of an abscess still be thought probable, the formation of adhesions by means of suture should be the next step before the introduction of an aspirating needle. In this way alone can we be sure that the needle when withdrawn after finding pus does not infect the healthy pleural surfaces. In case a pus focus is not discovered by means of a needle plunged in different directions through adherent pleura into the lung tissue, we should not hesitate to go further in case other signs point to the existence of an abscess. An incision can without danger be made into the lung tissue with the knife or thermocautery, or the finger or blunt instrument can be bored in until a cavity is reached or the hæmorrhage has become too free. By inserting gauze into a canal thus made the breaking through of pus is favored, and eventually the abscess may be evacuated. A number of cases have been recorded in which this favorable result has occurred. The danger of serious hemorrhage is not great in the superficial portion of the lung, and it is not until the larger vessels of the deeper parts are reached that the bleeding becomes profuse. Had this direct exploration of the lung been more often practised, fewer cases would be on record where the abscess cavity had been left unopened and discovered only at autopsy. Besides, in not finding the abscess the operation may result in a fatal pneumothorax or infection of the healthy pleura. Should a complete pneumothorax and resulting collapse symptoms occur in spite of the precautionary measures already spoken of, the patient may be saved by prompt measures. The lung may be seized with tenaculum forceps and drawn forcibly against the wound in the pleura and retained there by sutures. Furthermore, the lung may be expanded by means of the O'Dwyer intubation tube or some similar apparatus. Should the pus be opened into the healthy pleura there is very great danger of a fatal empyema, especially in a person already septic and weakened. An attempt should be made, however, to provide for proper drainage at the most dependent part of the thoracic cavity. For this purpose resection of a portion of the ninth rib should be done.

Most of the other bad results from operation for acute meta-pneumonic abscess of the lung may be put down to non-recognition of the abscess and consequent delay in operating until the patient's condition has become too poor from sepsis to expect anything but a fatal outcome, or to the existence of multiple abscesses secondary to the original one or to some other complicating process. These bad results seem, therefore, nearly all avoidable, provided that the case comes under the physician's observation from the beginning. Better results from operation will follow from more prompt recognition on the part of the internist of the existence of an abscess, a more accurate diagnosis of the location of the same, and from earlier operative intervention. The mortality at the present time is far higher than it should be, and in reality should approach that of empyema. The mortality as given in statistics, such as Tuffier (23.8 per cent.), which are computed from published cases, seems lower than it really is, as shown in unpublished records taken from one or more hospitals. Here will be found the successful and unsuccessful cases recorded together. I have made such a compilation of hospital cases which have been operated on during the last ten years. This shows a mortality of 50 per cent.

As regards operative technique, certain points seem of special importance. In the first place, the incision is preferably curved with convexity downward, and should correspond to the lower level of the abscess. This will insure the best drainage, and will permit of added resections of ribs at a higher level. One or preferably two ribs are resected for a sufficient distance and, later, if necessary, further resections may be added. The parietal pleura should be then carefully inspected to detect any thickening, adhesions, or other abnormality. The existence of adhesions is of great practical importance, as we have already seen, and fortunately are the rule in abscess cases. Tuffier found that they were present in 87 per cent. of the cases. In some instances there is a localized exudate, seropurulent in character, between the two pleural surfaces. The method used for the production of adhesions has changed considerably in the evolution of lung surgery. Quincke, an acknowledged authority on abscess of the lung, still uses his cauterization method. Applications of chlorid of zinc paste are made repeatedly for several days, and at the end of two weeks adhesions are usually present. Other observers claim that they have had no results from this method. It is certainly unsurgical, and does not appeal to the aseptic operator. Suture of the two surfaces seems to be the method of choice. Inclusion of lung tissue by the stitches has the advantage of greater security of the line of suture. The additional use of gauze packing is highly recommended by some and certainly helps in the production of broad adhesions. It is desirable to form a sufficiently large area of adhesions, as the movements of the lung find in this way greater resistance, and the sutures are less likely to tear out. Furthermore, a larger area of the lung lies attached in the wound, and any slight error in the diagnosis of the location of the abscess will be of less consequence. Round needles are preferable, and Garré recommends inserting them during expiration and covering the pleura with the finger during inspiration.

If the suturing has been done satisfactorily, the incision of the pleura can be done at once without putting it off to a second sitting. If, however, the patient's condition is good the delay of a couple of days will doubtless ensure stronger adhesions without lessening the patient's chances.

If the strength of existing adhesions is in doubt, sutures should be used for reinforcement, so that the introduction of the scalpel or trocar will not cause the adhesions to give away, followed by pneumothorax and separation of the lung from the field of operation. This experience happened to me in operating upon an abscess of embolic origin. The pus had been located by means of the aspirating needle passed through an adherent portion of the pleura. Upon inserting a sharp-pointed knife along the needle, the weak adhesion gave away, air entered, and the lung receded out of reach. A strip of gauze was hastily packed into the pleural cavity so as to come in contact with the area of the lung that had been adherent. The patient suffered no ill effects from the pneumothorax and a few days later the abscess perforated into the gauze packing. Within a short time the pus ceased to discharge, the fistula closed, and the patient made a perfect recovery.

As regards the method of dividing the lung tissue before reaching the abscess, surgeons hold various opinions. The general rule seems to be that the thermocautery (at a red heat) is preferable when the lung tissue is soft and vascular, as the oozing is undoubtedly checked and infection is less likely to penetrate the line of incision. The knife, however, is more suited to indurated tissues and does not obscure the tissues as does the cautery. The tip of the forefinger is an effective instrument in boring into lung tissue, and has been recommended by many operators expert in this branch of surgery.

The cavity having been opened, the treatment is similar to that of most abscess cavities, with the exception that irrigation should not, as a rule, be employed. The danger of spreading the infection into the adjacent tissues and, particularly when there is a communication with a bronchus, into other parts of the lung, is a real one, and fatal results have undoubtedly been caused in this way. In exceptional cases of gangrenous abscesses, with very foul contents and no communication with a bronchus, it may be desirable to run some risk on account of the detriment of the patient from the continued absorption from the septic contents. In one extensive abscess, with a large amount of secretion, I obtained the best drainage by means of a long tube connected with a bottle at the side of the bed. The dressings remained comparatively dry and thus their frequent change, which would have been necessary in case a short tube had been used, was done away with, which is no small consideration in the cases of these weakened individuals. Tube drainage seems to me preferable to any other in large abscesses. The danger of erosion of vessels from pressure is not present here as in chronic abscesses and bronchiectases, and hence the precaution of covering the tube with gauze is not essential. I have tried in all cases to keep these patients out of doors as much as possible on the roof or fire-escape. Their general condition is immensely improved thereby; they sleep better, their appetite improves and recovery seems hastened. The average time for healing seems about eight to ten weeks. This depends a good deal upon the length of time that the abscess has existed before operation. In the long standing cases the fistula may remain open for many months. Subsequent examination of the lung fails to show anything abnormal left behind by the abscess, and it is only very exceptionally that an inflammatory process is started up afresh.

If we turn to abscesses of origin other than lobar pneumonia we find the results from operative treatment are, generally speaking, far less favorable.

Embolic abscesses are frequently multiple, and in that case are not adapted to surgical treatment. Furthermore, the cases in which the abscess in the lung is single, are frequently associated with purulent foci elsewhere in the body, and thus offer a poor outlook for recovery, even though the pulmonary focus is found and drained. Operation, however, should be attempted in suitable cases and the abscess opened and drained, just as in the meta-pneumonic abscess. Williams reported an abscess of the lower lobe following septic miscarriage in which adhesions were present, and the recovery followed incision and drainage. I had recently a successful case of embolic abscess in which there were three other pus foci in the body. The small single abscess in the lung was successfully opened and drained.

Abscesses following influenza-pneumonia are frequently multiple on account of the breaking down of disseminated areas of consolidation. They do not usually communicate with a bronchus, and run a more chronic course. The prognosis is hence distinctly worse than in the single abscesses of lobar pneumonia. Should the purulent foci be close to each other it may be possible to drain them by opening up one abscess and breaking down the intervening tissue. In general, however, operative treatment should not be extended to this multiple form of suppuration. Abscesses due to the aspiration of foreign bodies also show an unfavorable prognosis. These abscesses usually belong to the chronic type, often become multiple and develop into bronchiestasis. It is seldom possible to find the foreign body after opening the abscess, and unless the body is coughed up or removed by means of a bronchoscope, the abscess does not heal. Out of 14 cases the foreign body could be found and removed through the wound in only two instances. Such patients usually succumb to prolonged suppuration or to pyæmia.

The following statistics based on 20 cases of acute abscess have been taken chiefly from the records of several of the large hospitals in this city. They are all cases that have been operated upon within the last ten years. All cases in which an abscess was not actually found within the substance of the lung at the operation or subsequent autopsy have been excluded from the list. Many cases were found tabulated in the records as " Abscesses of the lung," which seemed from careful perusal to be cases of sacculated empyema or empyema that had ruptured into the lung and bronchus. These were naturally excluded as well as all cases in which there were insufficient data as to the duration, nature of the abscess, etc. I have selected the acute cases of abscess for the reasons given at the outset of this paper. I have been impressed with the rarity of the condition, as shown by the surgical records. As regards the sex, the relative frequency in males is rather striking—17 males and 3 females. Etiology shows a decided preponderance of pneumonia as the underlying—15 cases.

The duration of pulmonary symptoms and the nature of the abscess have seemed of special importance as bearing upon the results of operative treatment. Abscesses of long duration and those with gangrenous contents show a bad prognosis. The two cases of multiple abscess died. With one exception all the cases of simple abscess of less than eight weeks' history and with non-gangrenous contents recovered. This case might, it seems to me, have recovered had not irrigation been used. All the gangrenous abscesses died; in one of them, however, the abscess was not found at the operation, but the autopsy showed that it was only an inch from the surface.

The operative result in the 20 cases shows a mortality of 50 per cent. This seems high, but when we consider that cases are here included of four and five months' duration before operation, and those of a gangrenous character, we realize that we are dealing with severe lesions. Without operation all such cases must necessarily be fatal. Our hope of good results seems to lie in the simple abscesses which are discovered early, before they have become extensive, multiple, or complicated by empyema, and before the patient has grown septic. Cases of lobar pneumonia which run an irregular course suggesting secondary empyema and in which pus is not obtained by trial puncture of the pleural cavity, should be regarded with suspicion. They should not be permitted to drag along in the medical wards until the favorable time for operating has passed. It is far safer to explore such cases by resection of one or more ribs, palpation and inspection of the pleura, search for an adherent area, and trial punctures of the lung through the adherent portion. If pus is present within the lung it should be found in this way at the time, or may be evacuated later spontaneously through the wound. If pus is not present, no harm has been done by the simple operative procedure at a time when the patient's general condition is good.

SYNOPSIS OF TWENTY CASES OF ABSCESS OF LUNG.

Case No.	Sex.	Age.	Etiology.	Duration of Pulmonary Symptoms.	Condition of Pleura.	Nature of Abscess.	Result.	Remarks.
1	M.	26	Secondary to abscess of liver.	3 months.	Adherent.	Simple.	Death.	
2	M.	50	Pneumonia.	3 weeks.	Adherent.	Gangrenous	Death.	
3	M.	42	Pneumonia.	8 weeks.	Adherent.	Simple.	Recovery.	Abscess cavity not found but ruptured subsequently into wound
4	M.	23	Embolic.	5 weeks.	Slightly adherent.	Simple.	Recovery.	Secondary abscesses in joints.
5	M.	43	Pneumonia.	4 weeks.	Adherent.	Multiple.	Death.	
6	M.	5	Pneumonia.	3½ wks.	Adherent.	Simple.	Recovery.	
7	M.	11	Metastatic (appendic.)	5 weeks.	Adherent.	Multiple.	Death.	
8	F.	23	Pneumonia.	4 weeks.	Adherent.	Gangrenous	Death.	Autopsy. Abscess not located at operation.
9	M.	25	Pneumonia.	3 weeks.	Adherent.	Gangrenous	Death.	Lived 6 weeks.
10	M.	40	Pneumonia.	4 weeks.	Adherent.	Simple.	Death.	Irrigation.
11	F.	22	Pneumonia.	5 months.	Associated empyema.	Simple.	Death.	Lived 3 months.
12	M.	21	Pneumonia.	4 months.	Adherent.	Simple.	Recovery.	
13	M.	53	Pneumonia.	4 weeks.	Adherent.	Simple.	Recovery.	
14	M.	38	Pneumonia.	3 weeks.	Adherent.	Simple.	Recovery.	
15	M.	28	Pneumonia.	4 months.	Sero-purulent exudation.	Gangrenous	Death.	Lived 5 weeks. Whole lower lobe involved.
16	M.	10	Pneumonia.	2 months.	Adherent.	Simple.	Recovery.	Previously broke into bronchus.
17	M.	40	Pneumonia.	4 weeks.	Adherent.	Simple.	Recovery.	
18	M.	25	Embolic.	3 weeks.	Adherent.	Simple.	Recovery.	
19	F.	55	Pneumonia.	3 weeks.	Adherent.	Simple.	Recovery.	
20	M.	17	Influenza.	4 weeks.	Adherent.	Gangrenous	Death.	